

# 國立暨南國際大學九十二學年度轉學生入學考試試題

第 1 節普通化學適用：(應化系二 341 )

(本試題共 3 頁，第 / 頁)

考生注意：1. 依次序作答，只要標明題號，不必抄題。

2. 答案必須寫在答案卷上，否則不予計分，並限以藍黑色筆作答。

3. 試題隨卷繳回。(餘詳詳閱試場規則)

1. (7%) A sealed balloon is filled with 1.00 L of helium at  $23^{\circ}\text{C}$  and 1.00 atm. The balloon rises to a point in the atmosphere where the pressure is 220. torr and the temperature is  $-31^{\circ}\text{C}$ . What is the change in volume of the balloon as it ascends from 1.00 atm to a pressure of 220. torr? ( $\text{He}=4.00$ )

2. (8%) How would you prepare 1.00 L of a 0.50 M solution of each of the following?  
( $\text{H}=1.00$ ;  $\text{Cl}=35.5$ ;  $\text{Na}=23.0$ ;  $\text{C}=12.0$ ;  $\text{O}=16.0$ ;  $\text{Cr}=52.0$ ;  $\text{K}=39.1$ )

- HCl from "concentrated" (12 M) reagent
- Sodium carbonate from the pure solid
- $\text{K}_2\text{CrO}_4$  from 1.75 M  $\text{K}_2\text{CrO}_4$  stock solution

3. (10%) Name and write the formula for each of the following compounds:

- $\text{NaCl}$
- $\text{AlI}_3$
- $\text{ZnCl}_2$
- $\text{Ca}_3(\text{PO}_4)_2$
- $\text{N}_2\text{F}_4$
- Ammonium hydrogen sulfate
- Cobalt (III) nitrate
- Lead (IV) sulfide
- Potassium cyanide
- Sulfur hexafluoride

4. (6%) Assume that  $4.19 \times 10^6 \text{ kJ}$  of energy is needed to heat a home. If this energy is derived from the combustion of methane ( $\text{CH}_4$ ), what volume of methane, measured at STP, must be burned? ( $\Delta H_{\text{combustion}}^{\circ}$  for  $\text{CH}_4 = -891 \text{ kJ/mol}$ )

5. (5%) Order the atoms in each of the following sets from the least exothermic electron affinity to the most.

- N, O, F,
- F, Cl, Br, I

6. (5%) Which of the following sets of quantum numbers are not allowed in the hydrogen atom? For the sets of quantum numbers that are incorrect, state what is wrong in each set?

- $n=4, \ell=3, m_{\ell}=4$
- $n=2, \ell=-1, m_{\ell}=1$

7. (5%) The lattice energies of  $\text{FeCl}_3$ ,  $\text{FeCl}_2$ ,  $\text{Fe}_2\text{O}_3$  are (in no particular order)  $-2631$ ,  $-5359$ , and  $-14,774 \text{ kJ/mol}$ . Match the appropriate formula to each lattice energy. Explain.

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(本試題共 3 頁，第 2 頁)

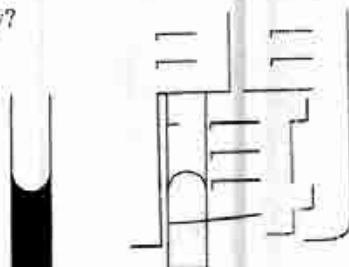
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8. (5%) How could you tell experimentally if  $\text{TiO}_2$  is an ionic solid or a network solid?

9. (6%) Predict which substance in each of the following pairs would have the greater intermolecular forces.

- $\text{CO}_2$  or  $\text{OCS}$
- $\text{HF}$  or  $\text{HBr}$
- $\text{SO}_3$  or  $\text{SO}_2$

10. (4%) The shape of the meniscus of water in a glass tube is different from that of mercury in a glass tube. Why?



$\text{H}_2\text{O}$  in glass

$\text{Hg}$  in glass

11. (10%) A 1.37 M solution of citric acid ( $\text{H}_3\text{C}_6\text{H}_5\text{O}_7$ ) in water has a density of  $1.10 \text{ g/cm}^3$ . Calculate the mass percent, molality, mole fraction, and normality of the citric acid. Citric acid has three acidic protons.

12. (10%) The rate of the reaction between hemoglobin (Hb) and carbon monoxide (CO) was studied at  $20^\circ\text{C}$ . The following data were collected with all concentration units in  $\mu\text{mol/L}$ . (A hemoglobin concentration of  $2.21 \mu\text{mol/L}$  is equal to  $2.21 \times 10^{-6} \text{ mol/L}$ ).

$[\text{Hb}]_0$ ( $\mu\text{mol/L}$ )	$[\text{CO}]_0$ ( $\mu\text{mol/L}$ )	Initial rate ( $\mu\text{mol/L/L}\cdot\text{s}$ )
2.21	1.00	0.619
4.42	1.00	1.24
4.42	3.00	3.71

- Determine the orders of this reaction with respect to Hb and CO.
- Determine the rate law.
- Calculate the value of the rate constant.
- What would be the initial rate for an experiment with  $[\text{Hb}]_0 = 3.36 \mu\text{mol/L}$  and  $[\text{CO}]_0 = 2.40 \mu\text{mol/L}$ ?

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13. (10%) At  $40^{\circ}\text{C}$ , the value of  $K_w$  is  $2.92 \times 10^{-14}$

a. Calculate the  $[\text{H}^+]$  and  $[\text{OH}^-]$  in pure water at  $40^{\circ}\text{C}$ .

b. What is the pH of pure water at  $40^{\circ}\text{C}$ ?

c. If the hydroxide ion concentration in a solution is 0.10 M, what is the pH at  $40^{\circ}\text{C}$ ?

14. (9%) Give the structure and draw for each of the following.

a. 3-hexene

b. *m*-diethylbenzene

c. 2-methyl-3-octene

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